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A10981944

## IN THE UNITED STATES PATENT AND TRADEMARK OFFICE

Inventors: Cao, *et al.*

Serial No: 09/248,740- 09217740

Examiner: D. Owens

Filed: 21 December 1998

Group Art Unit: 2811

Title: Local oxidation of a Sidewall Sealed Shallow Trench for Providing Isolation Between Devices of a Substrate

Declaration of Cao, *et al.* under 37 CFR 1.131THE COMMISSIONER OF PATENTS AND TRADEMARKS  
Washington, D.C. 20231

I, Paul Vande Voorde, hereby declare as follows:

1. I have been employed by the Hewlett-Packard Company since April 1, 1981.
2. I am a co-inventor, along with Min Cao, Wayne Greene, and Malahat Tavasolli, on the accompanying invention disclosure (Exhibit A). The invention disclosure was submitted to the Hewlett-Packard Legal Department on 3 October 1996. It was assigned Attorney docket number 10961260. Attached to the invention disclosure is page 19-22 of notebook HPL 2004. On this page, we described our invention. The page is dated 17 September 1996. Carlos H. Diaz read and understood the invention on 17 September 1996.
3. I further declare that all of the statements made herein are of my own knowledge, are true, and that all statements made on information and belief are believed to be true; and further that these statements were made with the knowledge that willful false statements and the like so made are punishable by fine or imprisonment, or both, under section 1001 of Title 18 of the United States Code, and that such willful false statements may jeopardize the validity of the application or any patent issued thereon.

Respectfully submitted,

Dated: 3/5/01

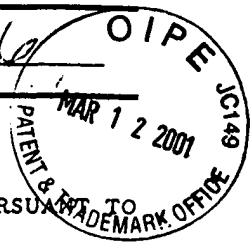
Paul Vande Voorde

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SEND TO: CORPORATE PATENT DEPARTMENT, M/S 20B-O, PALO ALTO, CA

PATENT DEPT. USE ONLY: ID-No. 10961260 ID-DTE: 10-3-96



### INVENTION DISCLOSURE

ATTENTION PATENT DEPARTMENT: THIS INVENTION DISCLOSURE IS SUBMITTED PURSUANT TO MY/OUR EMPLOYMENT AGREEMENT WITH HEWLETT-PACKARD COMPANY.

TITLE: Local Oxidation of Sidewall sealed Shallow Trench for Device Isolation

#### INVENTOR(S):

Min Cao 0419 ULSI Lab  
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Paul Vande Voorde 0419 ULSI Lab  
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IN WHAT PROJECT OR PRODUCT IS THE INVENTION USED OR PLANNED FOR USE?

LIST ANY PUBLICATIONS OR OTHER DOCUMENTS WHICH DISCLOSE FEATURES OF THE INVENTION OR WHICH DISCUSS OTHER SOLUTIONS TO THE PROBLEM SOLVED BY YOUR INVENTION:

IMPORTANT NOTICE: A patent application must be filed in the United States Patent & Trademark Office before this invention is: (1) disclosed outside HP; (2) published; (3) used in manufacture; or (4) sold. Have any of these events occurred? If so, please specify, including dates.

<u>Min Cao</u>	<u>9/17/96</u>	RECEIVED MAR 14 2001 TECHNOLOGY CENTER 2800
Signature of Inventor	Date	
<u>Paul Vande Voorde</u>	<u>9/17/96</u>	
Signature of Inventor	Date	
<u>Wayne Greene</u>	<u>9/17/96</u>	
Signature of Inventor	Date	
<u>Malakat Tavassoli</u>	<u>9.17.96</u>	
Signature of Inventor	Date	

#### HP PROPRIETARY

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Exhibit A

Title: Local oxidation of Sidewall Sealed shallow Trench for Silicon Device Isolation.

- Motivation:
1. Isolation technology is moving from LOCOS to Shallow Trench as <sup>the</sup> density of the chip increases.
  2. The trend in shallow trench Isolation is that pit island pitch decreases ~~the~~ to improve density while trench depth increases to provide adequate isolation while not degrading source/drain junction capacitance. Two challenges are facing us as a result of this trend:
    - (1). trench fill (oxide) is will become more difficult.
    - (2). Isolation will become less effective if depth of the trench maintains a constant.

Min Cao

9/17/96

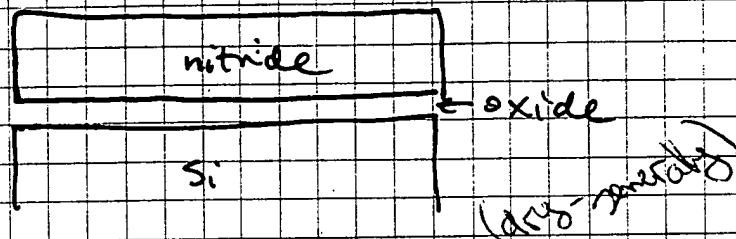
C. H. Diaz

09/17/96

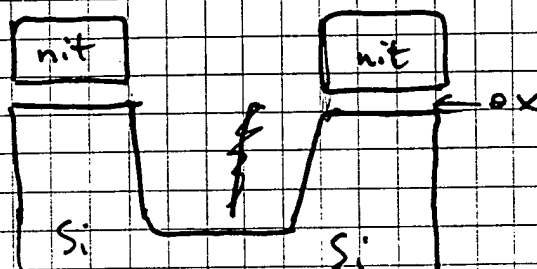
# New Approach, Local oxidation of sidewall sealed Shallow trench.

Process sequence:

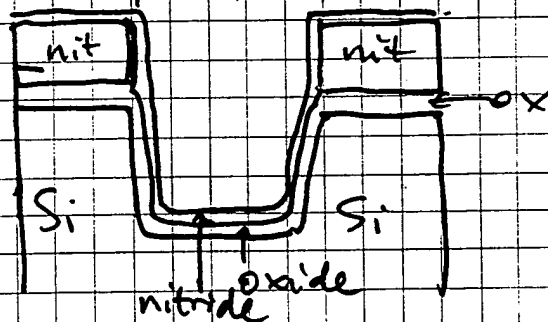
- (1) Deposit nitride layer on top of a layer of oxide



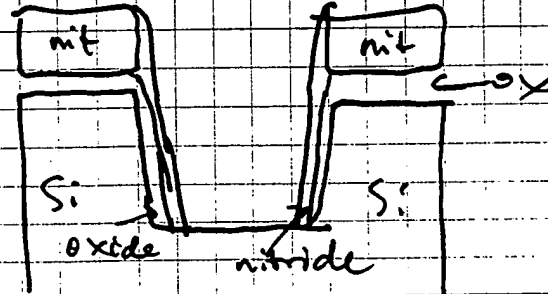
- (2) ~~Etch~~ Pattern island and etch nitride/oxide/Si



- (3) Grow a layer of oxide and deposit a layer of nitride



- (4) Etch ~~nitride/oxide~~ nitride/oxide



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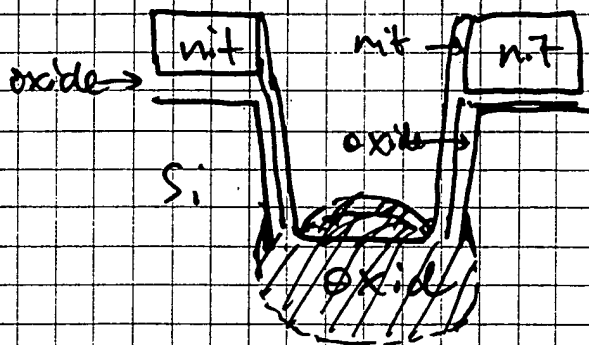
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QSD

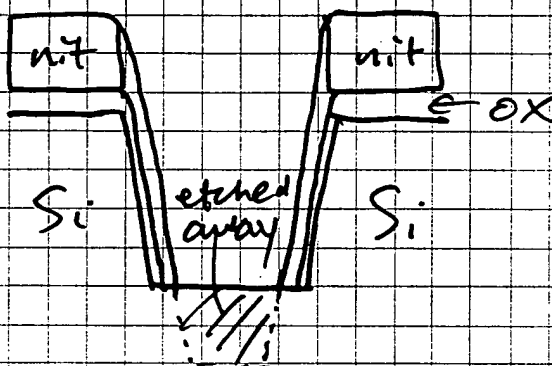
17 CHD  
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(5) We can have two different approaches at this stage

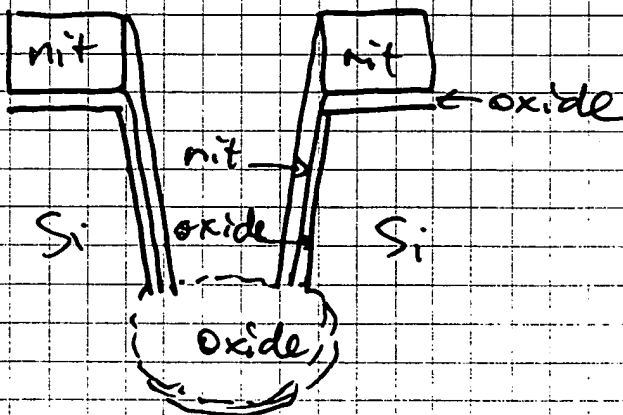
Approach (I): direct oxidation



Approach (II): further etch Si



(6) follow Approach (II) direct oxidation



(7) Standard oxide fill and polishing back

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22

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Q.S. 1

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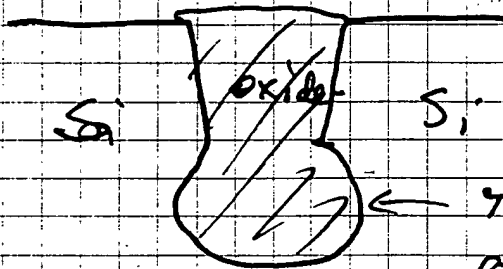
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17 cdb

## Advantages of the new approach:

- 1.1) Trench fill is easier, since there is no need to fill the entire trench depth
- 1.2) Isolation is more effective due to the shape of isolation.



\* Simulation result is attached

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4/17/96

Cao

09/17/96

Date

1000°C oxidation

TMA TSUPREM-4 (6.3H)

